A method for aligning two or more printhead modules (2) mounted to a support member (3) in a printer, the method including:

- positioning the printhead modules (2) on the support member (3) such that they align when the support member (3) is at its operating temperature but not necessarily at other temperatures.
SYSTEM FOR ALIGNING A PLURALLY OF PRINTHEAD MODULES

[0001] Continuation Application of U.S. Ser. No. 10/129,437 filed on May 6, 2002

FIELD OF THE INVENTION

[0002] The present invention relates to printers, and in particular to digital inkjet printers.

CO-PENDING APPLICATIONS

[0003] Various methods, systems and apparatus relating to the present invention are disclosed in the following co-pending applications filed by the applicant or assignee of the present invention on May 24, 2000:

- PCT/AU00/00578
- PCT/US00/00579
- PCT/US00/00580
- PCT/US00/00581
- PCT/US00/00582
- PCT/US00/00583
- PCT/US00/00584
- PCT/US00/00585
- PCT/US00/00586
- PCT/US00/00587
- PCT/US00/00588
- PCT/US00/00589
- PCT/US00/00590
- PCT/US00/00591
- PCT/US00/00592
- PCT/US00/00593
- PCT/US00/00594
- PCT/US00/00595
- PCT/US00/00596
- PCT/US00/00597
- PCT/US00/00598
- PCT/US00/00599
- PCT/US00/00578

SUMMARY OF THE INVENTION

[0007] To reduce the production and operating costs of pagewidth printers, the printhead may be made up of a series of separate printhead modules mounted adjacent one another, each module having its own printhead chip. To ensure that there are no gaps or overlaps in the printing produced by adjacent printhead modules it is necessary to accurately align the modules after they have been mounted to a support beam. Once aligned, the printing from each module precisely abuts the printing from adjacent modules.

[0008] Unfortunately, the alignment of the printhead modules at ambient temperature will change when the support beam expands as it heats up to the temperature it maintains during operation.

[0009] Accordingly, the present invention provides a system for aligning two or more printhead modules mounted to a support member in a printer, the system including:

- positioning the printhead modules on the support member such that they align when the support member is at its operating temperature but not necessarily at other temperatures.

[0011] Preferably, the support member is a beam and the printhead modules include MEMS manufactured chips having at least one fiducial on each;

[0012] wherein,

[0013] the fiducials are used to misalign the printhead modules by a distance calculated from:

[0014] i) the difference between the coefficient of thermal expansion of the beam and the printhead chips;

[0015] ii) the spacing of the printhead chips along the beam; and,

[0016] iii) the difference between the production temperature and the operating temperature.

[0017] Conveniently, the beam may have a core of silicon and an outer metal shell. In a further preferred embodiment, the beam is adapted to allow limited relative movement between the silicon core and the metal shell. To achieve this, the beam may include an elastomeric layer interposed between the silicon core and metal shell. In other forms, the outer shell may be formed from laminated layers of at least two different metals.

[0018] It will be appreciated that this system requires the coefficient of thermal expansion of the printhead chips to be greater than or equal to the coefficient of thermal expansion of the beam, otherwise the “gaps” left between the printhead
modules as compensation at ambient temperature will not close as the beam reaches the operating temperature.

BRIEF DESCRIPTION OF THE DRAWING

[0019] A preferred embodiment of the invention will now be described, by way of example only, with reference to the accompanying drawing in which:

[0020] FIG. 1 shows a schematic cross section of a printhead assembly according to the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0021] Referring to the figure the printhead assembly 1 has a plurality of printhead modules 2 mounted to a support member 3 in a printer (not shown). The printhead module includes a silicon printhead chip 4 in which the nozzles, chambers, and actuators are manufactured using MEMS techniques. Each printhead chip 4 has at least 1 fiducial (not shown) for aligning the printheads. Fiducials are reference markings placed on silicon chips and the like so that they may be accurately positioned using a microscope.

[0022] According to one embodiment of the invention, the printheads are aligned while the printer is operational and the assembly is at the printing temperature. If it is not possible to view the fiducial marks while the printer is operating, an alternative system of alignment is to misalign the printhead modules on the support beam 3 such that when the printhead assembly heats up to the operating temperature, the printheads move into alignment. This is easily achieved by adjusting the microscope by the set amount of misalignment required or simply misaligning the printhead modules by the required amount.

[0023] The required amount is calculated using the difference between the coefficients of thermal expansion of the printhead modules and the support beam, the length of each individual printhead module and the difference between ambient temperature and the operating temperature. The printer is designed to operate with acceptable module alignment within a temperature range that will encompass the vast majority of environments in which it expected to work. A typical temperature range may be 0° C. to 40° C. During operation, the operating temperature of the printhead rise a fixed amount above the ambient temperature in which the printer is operating at the time. Say this increase is 50° C., the temperature range in which the alignment of the modules must be within the acceptable limits is 50° C. to 90° C. Therefore, when misaligning the modules during production of the printhead, the production temperature should be carefully maintained at 20° C. to ensure that the alignment is within acceptable limits for the entire range of predetermined ambient temperatures (i.e. 0° C. to 40° C.).

[0024] To minimize the difference in coefficient of thermal expansion between the printhead modules and the support beam 3, the support beam has a silicon core 5 mounted within a metal channel 6. The metal channel 6 provides a strong cost effective structure for mounting within a printer while the silicon core provides the mounting points for the printhead modules and also helps to reduce the coefficient of thermal expansion of the support beam 3 as a whole. To further isolate the silicon core from the high coefficient of thermal expansion in the metal channel 6 an elastomer layer 7 is positioned between the core 5 and the channel 6. The elastomer layer 7 allows limited movement between the metal channel 6 and the silicon core 5.

[0025] The invention has been described with reference to specific embodiments. The ordinary worker in this field will readily recognise that the invention may be embodied in many other forms.

1. A system for aligning a plurality of printhead modules mounted on a support member in a printer wherein the support member is a beam and the printhead modules include MEMS manufactured chips having at least one fiducial on each;

   wherein,

   the fiducials are used to misalign the printhead modules at ambient temperature by a distance calculated from:

   i) the difference in coefficient thermal expansion between the beam and the printhead chips;
   ii) the spacing of the printhead chips along the beam; and,
   iii) the difference between the production temperature and the operating temperature.

2. A system for aligning a plurality of printhead modules mounted to a support member and a printer according to claim 1 wherein the beam has a core of silicon and an outer metal shell.

3. A system for aligning a plurality of printhead modules mounted to a support member in a printer according to claim 2 wherein the beam is adapted to allow limited relative movement between the silicon core and metal shell.

4. A system for aligning a plurality of printhead modules mounted to a support member in a printer according to claim 2 wherein the beam has an elastomeric layer between the silicon core and metal shell to permit the limited relative movement.

5 A system for aligning a plurality of printhead modules mounted to a support member in a printer according to claim 4 wherein the outer shell is formed from laminated layers of at least two different metals.

* * * * *